In-Situ characterization of the thermal and elastic behavior of rectifier diodes under working conditions

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A widely extended application in semiconductor-based technology is the use of rectifier diodes in vehicles alternators to convert part of the mechanical energy into electrical energy[1]. The most common failures in electric alternators are due to the electrochemical corrosion of the diodes or to damages as a consequence of the high current that circulates through diodes, which causes a significant temperature increase[2]. This temperature increase is one of the system weakness, affecting directly to the device operation parameters. The multicomponent nature of diodes, which are built up by different materials (epoxies, metals and semiconductors) with different physical characteristics and, therefore, with different behavior, is responsible of the appearance of diverse damaging phenomena such as the mechanical stress generation in the device.

This work shows the structural, compositional and physical characteristics of several diodes, currently used in automotive alternators. A study of the diodes has been carried out under certain working conditions which can lead to system failures, as well as to some phenomena allowing to understand their working mode. Some techniques such as confocal Raman microscopy and infrared thermography have allowed an *in operando* study of the diodes in forward biased and reverse biased conditions. The results show the device behavior at the interfaces, the generated stress in the different components and some system failure modes.

References

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(2) Ayadi, M.; Ghariani, M.; Toumi, A. Rectifier Dynamic Electro-Thermal Simulation for Power Factor Correction in Electric Vehicles Application. *J. Electr. Eng. Technol.* **2016**, *11* (5), 1153–1164.

Figures

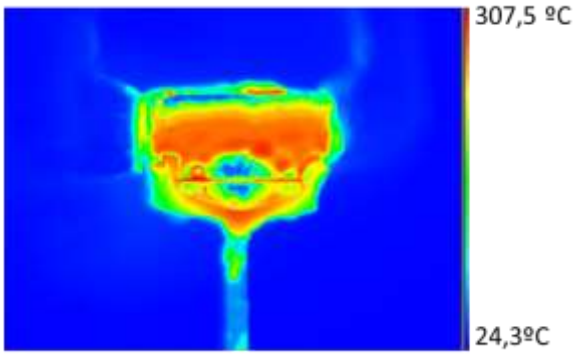

Figure 1. Thermograph of one cut diode after breakdown at reverse polarization.